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Flame-Resistant Thin Panels of Glass Fabric-Polyimide Resin Laminates

The problem:

Laminates consisting of glass cloth or fabric impregnated with aromatic polyimide resins have provided the reinforced-plastic composites designer an excellent nonmetallic structural material for use at elevated temperatures. In some applications, where weight and thickness of the structural parts must be minimized, relatively few plies of the glass fabric (typically style 181E glass) are used in the laminate. In conventional practice, the polyimide resin comprises about 30 percent by weight of the finished laminate. It has been found, however, that laminates of this composition in thicknesses of less than 0.08 inch are flammable or not self-extinguishing under certain conditions.

The solution:

An experimental investigation has conclusively shown that with a cured polyimide resin content of less than about 20 percent by weight of the finished part, glass fabric laminates which have good structural properties and are self-extinguishing in a pure oxygen atmosphere can be prepared in the thickness range of 0.035 to 0.08 inch. When the thickness of the laminate exceeds about 0.08 inch, the polyimide resin content can be higher than 20 percent by weight, because the thicker laminates are less flammable in air or oxygen-rich atmospheres. On the other hand, when the thickness of the laminate is less than about 0.035 inch, which corresponds to four plies of style 181E glass fabric, the laminate may have significant flammability in oxygen-rich atmospheres, despite a low resin content. In any event, the resin content of the laminates should exceed about 12 percent by weight, since lower

concentrations yield parts of inferior structural properties.

Flammability tests were conducted on 2-1/2 in.-wide \times 5 in.-long panels of glass fabric-polyimide resin laminates of various thicknesses and resin content, using an RTV silicone elastomer as an igniter. This igniter produced a peak flame temperature of about 3200°F and a total energy of about 2500 calories in 30 seconds. The glass laminates, in the thickness range of 0.035 to 0.080 inch and greater, bonded with less than 20 percent polyimide resin, were found to be self-extinguishing in a 100 percent oxygen atmosphere at a pressure of 16.5 psia. In these tests the ignition source was positioned to be in contact with the bottom edge of the specimen. All specimens thicker than about 0.035 inch were found to be self-extinguishing, with less than 2 inches of flame propagation along the length of each specimen. The maximum flame travel along the specimen decreased as the laminate thickness increased. With specimens containing more than 20 percent by weight of polyimide resin, the flame propagated completely along the 5-inch length without self-extinguishing.

Note:

The glass fabric-polyimide resin laminates can be formed by conventional methods, taking appropriate steps to obtain high-density (greater than about 100 lb/ft³) laminates with the prescribed low-resin content.

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act 42 U.S.C. 2456 (f), to the North American Rockwell Corp., 12214 Lakewood Blvd., Downey, California 90241.

(continued overleaf)

Source: R. A. Kaumeyer and S. Y. Yoshino of
North American Rockwell Corp.
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